# ORIGINAL ARTICLES

## Scientific and General

### GASTRIC RESECTION FOR PEPTIC ULCER *

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TWENTY years ago the acrimonious debate concerning the superiority of medical or surgical treatment of peptic ulcers occupied a prominent place in the literature and in medical meetings. The contentions of the internists and surgeons both had merit. They have now been reconciled, and opinions relative to the proper spheres of medical and surgical treatment have reached substantial agreement.

Duodenal ulcer is now considered to be primarily a medical problem. About 80 per cent of patients will respond to adequate therapy.[1] The remainder will develop complications, or their ulcers will prove intractable to medical treatment, and surgical intervention will be necessary. A larger proportion of ulcers of the stomach demand operative procedures due to the greater difficulty of accurate diagnosis, the hazard of malignancy and the need for more certain evaluation of the response to medical treatment.[2]

#### ETIOLOGY

The exact etiology of peptic ulcers has not been established. There is no complete explanation of the occurrence of ulcers and their recurrence after supposed complete healing under proper care. No adequate reason for their association with severe burns,[3] certain brain lesions [4] and other conditions has yet been conclusively demonstrated. Since the work of Sippy and others in the clinical care of ulcers, and the experimental work of Mann and Williamson,[5] and others, evidence has been progressively accumulating to give prominence to the acid factor in causation and maintenance of ulcers. The recent experimental production of ulcers in animals by the intramuscular implantation of histamin in beeswax has served to emphasize its importance.[6, 7] Certain hygienic, nutritional, and psychological influences demand attention and correction, if possible, but principal surgical interest centers about the acid levels. Until the entire etiology of ulcers has been unfolded, we must direct our therapy toward control of this important factor.

#### BACKGROUND OF OPERATIVE PROCEDURES

Two decades ago, a variety of operative procedures was employed and to some extent the same situation pertains today. There is, however, increasing agreement that radical resection of the stomach is the operation of choice, except in acute

perforations, and when certain technical considerations or extreme hazards indicate less extensive procedures. As the superiority of the radical operation has been demonstrated, the ranks of those advocating gastro-enterostomy, gastroduodenostomy, pyloroplasty and similar procedures have progressively diminished.

The physiological basis of radical resection lies in the fact that the level of free hydrochloric acid is determined by the number and activity of acid-secreting cells, and the freedom of regurgitation of duodenal contents into the stomach. Berger [8] has demonstrated that the parietal cells are found in important numbers only in the corpus and fundus, and that the former is larger and presents greater concentration of cells. The gastric phase of secretion results from stimulation by food in the stomach, and there is clinical and experimental evidence that the antrum and pylorus are important in this regard.[9, 10, 11, 12, 13] The duration of the gastric phase is limited by the emptying time of the stomach.[7, 14] The regurgitation of alkaline duodenal content neutralizes free acid.[15, 16, 17]

An operation, to effectively reduce acid levels, must, therefore, remove a large proportion of the acid secreting cells, eliminate the indirect influence of the antrum, decrease the emptying time of the stomach and provide free regurgitation of duodenal contents. This entails excision of the pylorus, antrum and a sizable portion of the stomach.

There is some question as to the amount of stomach which must be removed to achieve the best results. Hunt,[18] Walters [19] and others believe that hemigastrectomy will accomplish almost as satisfactory results as more extensive resections. Wangensteen [13] maintains three-fourths of the stomach must be excised to obtain the greatest benefit. These surgeons are accurate in their estimates of the amount of stomach removed. Wangensteen [7] and Hunt [18] have devised methods of measuring the stomach. We believe that many surgeons have a tendency to overestimate the amount of stomach removed and suggest the adoption of a uniform plan of measurement and record. The indefinite terms "partial," "extensive" and "subtotal" should be discarded, and the extent of resection should be expressed in the fraction of stomach removed.

We agree with Wangensteen [13] that the objectives of operation are: "(1) That it relieve the patient subjectively and remove the ulcer diathesis; (2) That it prevent recurrent ulcer; (3) That it do not compromise the future of the patient."

#### ON RESECTION OF THE STOMACH

As yet no treatment, operative or otherwise, has consistently fulfilled these criteria; but the closest approach has been made by resection of the stomach which has been sufficiently radical to produce achlorhydria.

It has been our plan to remove two-thirds of the stomach in most cases. Occasionally, particularly in the case of high gastric ulcers, we have removed more. Our purpose is to remove enough of the stomach to secure at least a relative achlorhydria. The importance of the acid factor rests on such a

firm experimental and clinical background that unless this is accomplished we believe the ultimate result to be jeopardized. A number of recent contributors have stated or implied that the occurrence of peptic ulcer in the human is primarily dependent upon unneutralized hypersecretion by the stomach.[20, 21, 22] It has been said that experimental ulcer has never been consistently produced except by methods which prevent neutralization of the acid chyme,[45] and that no clinical ulcer has been demonstrated conclusively in the presence of actual achlorhydria.[21] Even if these statements be not entirely accurate, they emphasize the importance of controlling the free hydrochloric acid level.

TABLE 1.—*Gastric Resection for Peptic Ulcers (1939-1942\*)*

| | Number | Deaths | Mortality Per Cent |
|---|---|---|---|
| Duodenal ulcers | 47 | 5 | 10.6 |
| Gastric ulcers | 21 | 0 | 0 |
| Gastrojejunal ulcers | 11 | 0 | 0 |
| Gastrocolic fistulae | 4 | 0† | 0 |
| Total | 83 | 5 | 6.0 |

81 two-thirds resections          2 limited resections
82 Polya (principally posterior)  1 Billroth I Anastomosis
A few duodenal ulcers left *in situ.*

\* To October 1, 1942.
† One patient died of pulmonary tuberculosis two months after resection.

### CLINICAL MATERIAL ON STANFORD SERVICE

During the past four years, eighty-three patients on the Stanford Surgical Service of the San Francisco Hospital have been submitted to extensive resection of the stomach for peptic ulcer. Eighty-one had resections of two-thirds or more of the stomach. One Billroth I anastomosis was made, the remainder were of the Polya type. A majority of these were retrocolic, but recently a majority have been anterior anastomoses. The anterior method allows removal of more stomach with ease of subsequent suture, and adds to the facility with which the operation can be accomplished. No entero-anastomoses have been made. These divert alkaline duodenal contents and sacrifice the advantage of neutralization of the acid secreted by the remaining stomach.

Suture methods have varied, but usually the full width of the stomach has been sutured to the jejunum with external rows of interrupted silk and internal continuous rows of fine chromicized catgut. The Hofmeister technique has been used in some cases.

The pylorus and antrum have been removed in all cases. We feel that the experimental work of Wangensteen and others, and the poor clinical results of the Finsterer technique make this necessary. If technical considerations interfere, we believe it wiser to perform a two-stage operation, as advocated by McKittrick [23] rather than the Devine operation [24, 25] or the mucosal resection of Bancroft.[26] It is important, when possible, to remove gastric ulcers and desirable to do so with duodenal ulcers. There is no great harm in leaving a duodenal ulcer, which is not actively bleeding, *in situ.* Even with much less radical procedures these ulcers heal. This is preferable to the hazard of attempting excision of ulcers in certain cases. The fatal outcome of two and perhaps three of the cases in this series might have been avoided by exercise of better judgment in this matter. One common duct injury followed by bile peritonitis and the perforation of an ulcer which had been too extensively freed before it was realized that removal would endanger the common duct account for two cases.

We place 8 to 12 grams of sulfanilamide in the abdominal cavity and wall prior to and during closure. We believe this has reduced our complications, particularly wound infections.

### INDICATIONS FOR OPERATION

Gastric resection is indicated for the complications of duodenal and gastric ulcers, and those resulting from previous surgical procedures. In some instances the indications are absolute, in others relative, and, occasionally, subject to controversy. The most controversial indication is "intractability," as a result of widely varying individual interpretation.

Our cases have been classified according to the predominant indication, when such was present. When two or more indications existed, the case was tabulated as intractable. The indications for opera-

TABLE 2.—*Distribution of Cases*

| Type | No. | Male | Female | Age | Duration of Symptoms | Gastric Analyses |
|---|---|---|---|---|---|---|
| Duodenal | 47 | 43 | 4 | 36-64, Av. 52 | 2 wks. (?)-50 yrs.  Av. 9½ yrs. | F 0-154, Av. 91<br>T 20-160, Av. 107 |
| Gastric | 21 | 17 | 4 | 36-77, Av. 51 | 1 mo.-28 yrs.  Av. 8½ yrs. | F 34-124, Av. 72<br>T 48-137, Av. 99 |
| Gastrojejunal | 11 | 11 | 0 | 35-55, Av. 47 | Prior to G. E. 0-23 yrs.  Av. 5½ yrs.<br>Gastroenterostomy 1-25 yrs.  Av. 14½ yrs.<br>Asymptomatic 0-19 yrs.  Av. 5½ yrs.<br>Recurrent symptoms four wks. 9 yrs. | F 38-90, Av. 61<br>T 60-106, Av. 81 |
| Gastrojejunocolic Fistulae | 4 | 4 | 0 | 41-72, Av. 53 | Prior to G. E. 0-21 yrs.  Av. 7 yrs.<br>Asymptomatic 1-12 yrs.  Av. 7 yrs.<br>Recurrent ulcer symptoms 0-16 yrs.  Av. 4 yrs.<br>Diarrhea 1-4 mo.  Av. 2 mo. | F 0-16, Av. 6<br>T 20-40, Av. 27 |

tion have been classified as: Hemorrhage, pyloric obstruction, perforation, intractability, gastro-jejunal ulceration and gastrojejunocolic fistula. Hemorrhage has been further subdivided into acute, recent and previous recurrent massive groups.

TABLE 3.—*Indications for Operation*

| | Acute | Recent | Previous Recurrent | Perfora-tion | Obstruc-tion | Intracta-bility |
|---|---|---|---|---|---|---|
| Duodenal | 5 | 8 | 5 | 3 | 11 | 17 |
| Gastric | 2 | 6 | 2 | 2 | 1 | 8 |

*Hemorrhage.*—Bleeding in some degree is inherent in all gastric and duodenal ulceration. Significant gross hemorrhage occurs in 25 to 35 per cent of cases.[27, 28, 29, 30] We consider massive hemorrhage that which produces sizable gross hematemesis, tarry or bloody stools, or both, associated with faintness or loss of consciousness, rapid pulse, fall in blood pressure, and marked reduction in hemoglobin and red cell count.

Those patients admitted to the hospital because of active bleeding of this type, and who were submitted to operation in the first few days for the purpose of arresting hemorrhage, are listed as cases of acute massive hemorrhage. Those who had experienced massive hemorrhage shortly prior to admission to the hospital, or who were admitted while bleeding, were carried beyond this phase by conservative means and then submitted to operation, are considered as cases of recent massive hemorrhage. Patients who had bled importantly on more than one occasion in the past but who had no recent history of gross bleeding are classified as previous recurrent hemorrhage.

We agree with the opinion of other observers that acute hemorrhage in patients below the age of forty-five should usually be treated by conservative means. Generalization is dangerous and each case should be considered individually. It is our experience and that of others that an occasional young patient will die of exsanguination, but the mortality rate of medical treatment will probably not exceed 5 or 6 per cent.[29, 31] This is lower than reasonably could be expected if all patients in this group were submitted to operation. It is occasionally necessary to operate upon a young patient who continues to bleed or has repeated hemorrhages. The decision is one which requires careful consideration and experienced judgment.

Patients beyond forty-five years of age must be viewed in a different light. Those in this age group stand hemorrhage from any source less well than younger persons. The bleeding vessel has a thicker wall which retracts less well and may be a rigid calcified tube in which effective thrombus formation is difficult. The mortality rate of conservative treatment in these patients is high, probably about 30 per cent,[1, 29, 30, 31] and is higher than would be expected from operation uniformly applied to this group.

These patients should be observed by the surgical staff from the time of admission, and unless there is evidence of prompt and complete arrest of hemorrhage, operation should not be long delayed. We agree with Allen, Walters, Finsterer [32] and others that operation should not be delayed much beyond forty-eight hours. If permitted to continue, hemorrhage will produce anemia, anoxemia of the tissues, lowered blood proteins, tissue edema, and malnutrition which greatly increase the risk.

When a patient who has not had a previously established diagnosis of ulcer enters the hospital, acutely bleeding from the upper gastro-intestinal tract, the surgeon is confronted by a difficult decision. If the patient is in the older age group, operation may be indicated for arrest of hemorrhage, but it is this same group which presents the majority of other causes for hemorrhage. The percentage of diagnostic errors is high. It can be reduced in some degree by carefully performed x-ray examination,[38] which may reveal an ulcer or esophageal varices. We have operated upon a few cases in which no ulcer was present.

Generous use should be made of transfusions whether patients are treated conservatively or radically. The widespread belief that the elevation of blood pressure due to transfusion may displace the clot in a vessel which has recently bled may have had some basis in fact but, at best, it must be rare. We have not encountered it even with the older, more rapid methods of transfusion. In fact, our experience has been to the contrary. We do not advocate transfusion of an actively bleeding patient unless this is urgently required, because the transfused blood may be lost, although we have seen patients apparently cease to bleed during or immediately following such transfusions. In eighty cases in which the blood pressure was above shock levels the average rise in systolic pressure caused by administration of 500 c.c. of blood was less than 5 mm. of mercury. This cannot be looked upon as a dangerous increase, and the value of transfusion in a patient suffering from the acute anemia of severe hemorrhage cannot be denied. With the increased availability of blood due to blood banks, we are using transfusions to an ever greater extent, before, during and after operation.

We have submitted seven patients to gastric resection during the actively bleeding phase, with one death.

Operation can be more safely performed after a patient has recovered from the effects of hemorrhage and has restored his hemoglobin, proteins, and nutrition. Operation must be considered in those patients who have had massive hemorrhage and have recovered from it. This is especially true when the hemorrhages have been repeated. The more frequent the hemorrhages in the past, the greater the likelihood of future bleeding.[34] A fairly large number of patients bleed once without previous or subsequent ulcer symptoms. These hemorrhages may come from acute, superficial ulceration which responds well to medical therapy. With repeated hemorrhages, and particularly in the older patients, the ulcer tends to be deeply eroding, and usually produces other symptoms as well. The prospect of success with conservative treatment is

poor, and these patients usually should be operated upon.

In this series there were fourteen instances of operation for recent massive hemorrhage and five for previous recurrent hemorrhage.

*Pyloric Obstruction.*—Cicatricial stenosis of the duodenum or pylorus of sufficient degree to interfere with emptying of the stomach is frequently seen in long-standing ulcers. It is more common in elderly patients and may be seen in the absence of other recent ulcer symptoms. It should not be confused with the obstruction resulting from edema surrounding an active ulcer, which may subside under proper medical regimen. Many ill-advised gastro-enterostomies have been performed in the past for this type of obstruction. Some degree of cicatricial stenosis and active ulceration are frequently present simultaneously. In these instances the ulcer is usually of the posterior penetrating type and operation is indicated.

Patients with obstruction often present low acid levels. The combination of obstruction, low acid, and the fact that a large number of these patients are elderly have influenced many surgeons to perform gastro-enterostomies in this group and some still advocate this procedure as the operation of choice. At first glance the problem appears to be one of providing an adequate mechanical outlet for the gastric contents.

Our experience has been that these patients get along very well for variable periods after gastro-enterostomy, but in a number, the subsidence of the associated gastritis [35] causes higher acid levels to return and these patients contribute importantly to the incidence of marginal ulceration. It is, therefore, our opinion that unless there is contraindicating systemic or technical consideration, these patients should be given the benefit of radical resection.

*Perforation.*—Our usual practice is to treat acute perforations by simple closure after taking biopsies of lesions not clearly distal to the pylorus. Occasionally, one encounters large callous ulcers which make closure difficult or in which closure obstructs the pyloric outlet. Five patients, three with duodenal and two with gastric ulcers were submitted to resection at the time of acute perforation. In all instances indications additional to acute perforation were present. We believe the less done to patients at the time of perforation the better, but in the occasional case which requires some procedure in addition to suture of the ulcer, resection is preferable to gastro-enterostomy.

*Intractability.*—This classification is the largest of both the duodenal and gastric ulcer groups. Many duodenal ulcers present long histories with multiple symptoms. In such cases, when no one complication was predominant, and when some medical treatment had been employed, the case was classified as "intractable." Very few patients were submitted to operation solely because of subjective symptoms which were sufficiently aggravated that "they could not live with their ulcers." The patients in this series were faced with economic and social limitations which interfered in some degree

with proper medical care. Educational deficiencies, alcoholism, and a lack of interest in pursuing medical treatment all contribute to the development of complications and the advisability of operative procedures.

The same circumstances pertain to the care of the patients with gastric ulcer, but the additional factor of malignancy occupies an important place. It is at times very difficult to determine whether an ulcer of the stomach is benign or malignant.[2, 36, 37, 38, 39]

The duration of symptoms, the size of the ulcer, its position in the stomach, its x-ray and gastroscopic appearance, the acid levels, and response to therapy all give valuable information, but occasionally, when all the evidence points toward a benign lesion, malignancy may still be present. A preoperative diagnostic error of 14 per cent after careful study has been reported by competent observers.[38] To a lesser extent, when the preponderance of evidence favors malignancy, a benign ulcer may be found, but this is of prognostic significance only.

A short history favors malignancy but does not rule out a benign lesion. It has been demonstrated that a majority of ulcers more than 2.5 cm. in diameter are malignant but 10 per cent of those with craters of less than 1 cm. are carcinomatous.[38] Ulcers of the lesser curvature and posterior wall tend to be benign and those elsewhere malignant.[30, 32] This is especially true of the greater curvature. Normal or increased acid values favor benign ulceration, but are commonly found in association with so-called "ulcer cancer"[38, 39, 40] X-ray and gastroscopic diagnoses are usually accurate, but are occasionally misleading, and more frequently inconclusive, even when made by experienced trained observers.

Most malignant ulcers have been carcinomatous from the start, but it has been fairly well demonstrated that certain long standing benign ulcers become malignant.[40] The number is certainly smaller than the original figures of McCarty, and may be smaller than the more conservative estimate of Stewart.[44] However small, it still requires consideration.

The preoperative differential diagnosis between benign and malignant ulcer is often extremely difficult. It is occasionally hard for the experienced surgeon to distinguish between them at the operating table, and the final diagnosis must be determined by microscopic examination.

Under these circumstances the indications for surgical intervention must be liberal. It is our opinion that a patient in whose case the majority of factors (*i. e.,* history, location, size, x-ray and gastroscopic appearance of the ulcer and acid levels) do not strongly indicate a benign lesion, should be submitted to operation at once. In those instances in which the evidence is predominantly in favor of a benign ulcer, the patient should be treated medically for a limited trial period, usually four weeks. If, in this time, improvement is observed as judged by symptomatic relief, diminution

in the size of the ulcer by x-ray and gastroscopic evidence of healing, conservative therapy should be continued. If not, or if there is subsequent interruption of progress, operation should not be delayed. Patients who respond favorably to medical care should be kept under close observation for long periods, and in the event of recurrence, operation should be seriously considered. It must be borne in mind that carcinomatous lesions may give evidence of protracted improvement under medical therapy.

Eight of the twenty-one cases of gastric ulcer were submitted to operation primarily because of doubt as to diagnosis or failure to respond to medical treatment.

*Gastrojejunal Ulcers.*—Most observers believe that gastrojejunal ulcers should be treated surgically. We agree with this point of view in general. The complications of marginal ulcers are serious. Most of these ulcers have gross hemorrhage. Free perforation is very difficult to deal with, and gastrojejunocolic fistula presents a major technical and nutritional problem. The frequency of marginal ulcers is probably greater than generally appreciated. It is usually the more serious ones which come to our attention. The findings in this series indicate that stomal ulcers may heal, recur and again heal, leaving comparatively little trace. Under certain circumstances medical treatment is justified, but in the majority of instances surgery should not be delayed long after establishment of the diagnosis.

*Gastrojejunocolic Fistulae.*—The indication for surgery in gastrojejunocolic fistulae is absolute.

### PREOPERATIVE PREPARATION

When time permits, as it does in elective cases, the patient should be carefully studied prior to operation. The risk of operation in the presence of chronic cardiac, vascular, renal or pulmonary disease must be evaluated, and balanced against the advantages of operation. Patients requiring operation often present rather marked nutritional disturbances. Adequate attention must be paid to anemia, dehydration, depletion of proteins and electrolytes, and avitaminosis. The usual oral or parenteral methods of restoring these lacks should be employed. We would like to stress the value of preoperative transfusions in the prevention of shock at the time of operation.

The stomach should be empty at the time of operation, and a Levine tube left in place during operation. In the presence of obstruction the stomach should be lavaged daily during the time of preparation, and constant suction applied for 24 to 48 hours immediately preceding operation. We have recently been lavaging the stomach with sulfanilamide just prior to operation. This probably has considerable value in cases of carcinoma, but seems superfluous with ulcers.

Patients with gastrojejunocolic fistulae are placed on succinysulfathiazole prior to operation, and preliminary colostomy in the ascending or right transverse colon is made after the plan of Pfeiffer.[42] The improvement of patients following this procedure is remarkable.

### POSTOPERATIVE CARE

Continuous suction is applied to the Levine catheter and maintained for about seventy-two hours. Audible peristalsis has usually been reëstablished by that time. The stomach is then aspirated, a measured amount of fluid, usually 300 c.c., is introduced and the tube clamped. The stomach is reaspirated at the end of three hours. If more than half of the fluid has passed out of the stomach, the tube is withdrawn and feeding by mouth cautiously begun. The diet is increased in amount and variety gradually. The patient is usually taking a soft, well-balanced diet within ten days of the time of operation.

The Levine tube has great value in the immediate postoperative period, but it presents disadvantages. Practically all patients complain of its presence, and not infrequently the "sore throat" resulting from the use of a tube constitutes the major discomfort of the convalescence. It may well increase the incidence of pulmonary complications and parotitis. Protracted use causes ulceration of the pharynx or esophagus. During the past year every patient coming to post mortem on our Service, from whatever cause (carcinoma, intestinal obstruction, peritonitis, etc.), in whom a tube had been employed for more than a few days, presented such ulceration. One patient in this series developed a stricture of the esophagus which was presumably benign, and possibly the result of protracted use of a Levine tube. Another factor of importance is the size of the tube. There is a tendency to use the larger tube because of the greater ease of passage and less frequent stoppage. We believe the smaller 12 F and 14 F to be less dangerous than the 16 F tubes.

Coller and Maddock [44] have demonstrated that the average postoperative patient, whose temperature is not high and who is experiencing no unusual fluid loss, requires 2,000 to 3,000 c.c. of fluid per day. One liter of normal saline and two of 5 or 10 per cent glucose in water cover his fluid and electrolyte requirements. Any deficit produced by gastric suction must be covered. Fluids, and particularly salt solution, in amounts greater than required, lead to production of edema and should be avoided. In cases of protracted parenteral intake the other electrolytes must be supplied. Special care should be observed in the amount and speed of administration of fluids to elderly patients and those with cardiac, vascular or renal disease.

Careful attention should be paid to blood chlorides and proteins. More than the usual requirements in vitamins should be provided parenterally until the patient is able to take them by mouth.

We have frequently used the oxygen tent in the early postoperative period with gratifying results.

We urge patients to follow an adequate but somewhat restricted diet for a long period. We advise frequent meals of a bland type containing little which would produce mechanical or chemical irritation. It is our belief that this regimen adds to the prospect of maximum benefit from operation. A small number of patients follow this advice but a

majority shortly resume diets and habits of their own preference.

## RESULTS

Five patients in the group died in the post-operative period. The cause of death in one was massive bilateral pneumonia. This was prior to the time of effective chemotherapy. One died of hemoplegia. Three deaths were due to technical errors or errors of judgment which can be avoided in the future. The overall mortality of 6 per cent is not unduly high for patients of the type we are called upon to treat in our hospital, but should and can be improved.

The ultimate evaluation of any gastric operation requires many years. It has not been uncommon for patients to be well for twenty years or more after gastro-enterostomy, and then develop serious complications. Gastric resection has not been performed upon a large enough number of cases over a sufficiently long time to justify some of the claims which have been made for it. We already know that it is not a certain guarantee against marginal ulceration, and it is probable, just as it was with gastro-enterostomy, that the incidence is greater than we suppose. It has been reported to be as high as 8 per cent,[43] but most observers consider this an unusual circumstance.

It can be safely said, however, that the early results are far superior to those of any other operative procedure, and evidence indicating that the same will be true of the late results is accumulating.

The follow-up in this series leaves much to be desired. Most of the patients have been followed for at least one year. During this period the results have been excellent on the whole. A number of patients complain of fullness, discomfort, cramps, and occasional diarrhea after large meals. The major portion result from dietary or alcoholic indiscretions.

Some patients have subsequently reëntered the hospital for unrelated reasons. These patients have all had good results. Three have been admitted for gastro-intestinal symptoms. One of these had a marginal ulcer one year after resection for gastro-jejunocolic fistula and has been well since a secondary resection. One was discharged, symptom-free, after negative investigation, and one was discharged three days after admission for gastric symptoms associated with alcoholism.

Not all of the patients were submitted to post-operative gastric analysis, but only two patients with free hydrochloric acid to single histamin stimulation were found. One of these was the gastrojejunal ulcer referred to above, and the other a patient submitted to limited resection.

## SUMMARY AND CONCLUSIONS

1. A series of eighty-three cases of resection of the stomach for the complications of peptic ulcer is presented.

2. The indications for operation, preoperative preparation, operative procedure, postoperative care and results are discussed.

3. Resection of two-thirds of the stomach, including the pylorus and antrum, is based upon

sound physiological principles, and is the operation of choice in most cases of peptic ulcer requiring surgical intervention.

490 Post Street.

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### Navy to Expand Coast Hospital Chain

Rear Admiral Ross McIntire, personal physician to President Roosevelt and surgeon general to the Navy, today in a press conference here announced plans for huge expansion of Navy West Coast hospital and convalescent facilities. . . .

He stated a temporary hospital will be erected at Astoria, Ore., for men in the air arm of the Navy stationed along the Oregon coast.

The Navy plans to have 60,000 hospital beds available by the end of the 1944 fiscal year, and another 20,000 by the end of 1945 fiscal year, all within the continental limits of the United States, he said.

Asked why Navy physical standards had been lowered, he said manpower for the Navy was low and that the Navy now planned on taking in men for limited duty to relieve others for sea duty.

Admiral McIntire praised the mobile base hospitals in the South Pacific, pointing out that the death rate was very low among the wounded.

He said medical cases in this war are much different from those of the last World War because of the extreme violence in the present conflict. . . . —San Francisco *News*, June 2.

## WELDING FUMES AND GASES: THEIR EFFECTS ON THE HEALTH OF THE WORKER*

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IN the present war effort, particularly in the building of ships, the process of welding has become so important as to be almost indispensable. It is, therefore, timely and opportune to speak of the effects of the fumes and gases, generated in the process of welding, on the health of the welder and his associates.

#### DANGERS TO THE WELDER IN MODERN ARC WELDING

Now, in modern arc welding there are at least three sources of danger to the worker. The first is that from the arc itself, where the temperature may reach over 6,000 degrees Fahrenheit. Such tremendous heat may be responsible for burns which heal but slowly. Besides this, the intense ultraviolet rays generated may produce eye-flashes, which are only too common. Then there is the hazard that arises from the presence of ozone, which is formed from the oxygen around the arc. The arc is also responsible for the nitrous fumes, which are generated by the combination of the nitrogen and the oxygen of the air. These so-called nitrous fumes consist of a varying mixture of the monoxide of nitrogen, the dioxide, the trioxide, the tetroxide, and the pentoxide, as well as nitrous and nitric acids. Of these, the dioxide is the most stable.

Coming now to the second source of danger, namely, the rods and their coverings, we have to take into account the production of not only the particulate fumes of iron, but also the fumes of any other metals and substances that enter into the composition of the rods. To mention only a few of the known metals, there are manganese, chromium, cadmium, nickel, zinc, and magnesium, each of which may produce its own symptoms of poisoning. The coating of the rods introduces further possible hazards from such substances as fluorides, silicates, varnish, rubber, etc.

Finally, we must not forget the factor of oxygen deficiency, particularly if the welding is done in a confined space where the ventilation may be poor.

#### CLINICAL ASPECTS

Turning to the clinical side of the problem, we may ask, what are the commonest and most outstanding complaints for which welding might be held responsible? About this there still exists much difference of opinion, and I believe that the best way to answer this question is to present the histories of some of the cases of welding fume and gas "poisoning" that I was able to study during July and August of 1942. As there is a notable lack of case reports in the literature, such histories may also prove interesting.